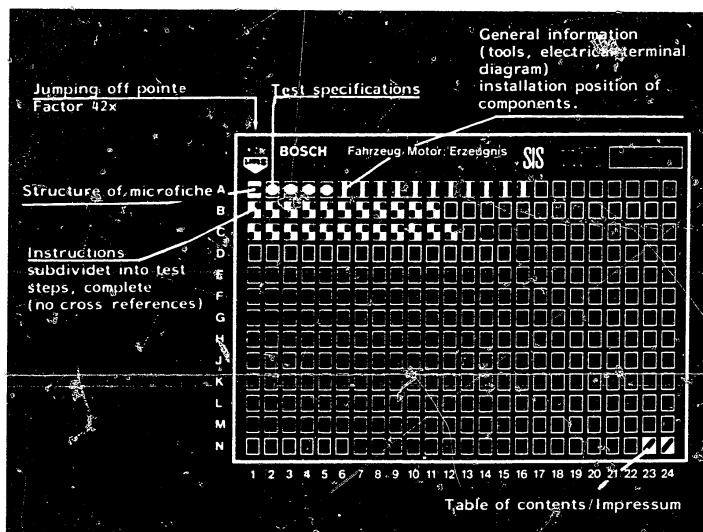


## Structure of microfiche

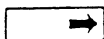


1. Read from left to right
2. Title of microfiche (appears on each coordinate)

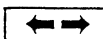
<b>E16</b>	Product/component/test step
	Vehicle/engine

Coordinate

3. Limits of section



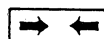
Beginning



Mid-section



End



One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6

**C6**

**A1**

Repair and testing





Caution!



When working on systems from 40 V d.c. upward, proceed in accordance with the general local safety regulations.



1. Test specifications

Overvoltage protection:

Response voltage	$U_s$	= 53.0 ... 55.0 V
Time delay	$t_s$	= 6.0 ... 20 $\mu$ sec
Voltage limitation	$D+/D-$	$\leq 75$ V
Test voltage	$U_p$	= 79.0 V...81.0 V

Consequential-damage protection:

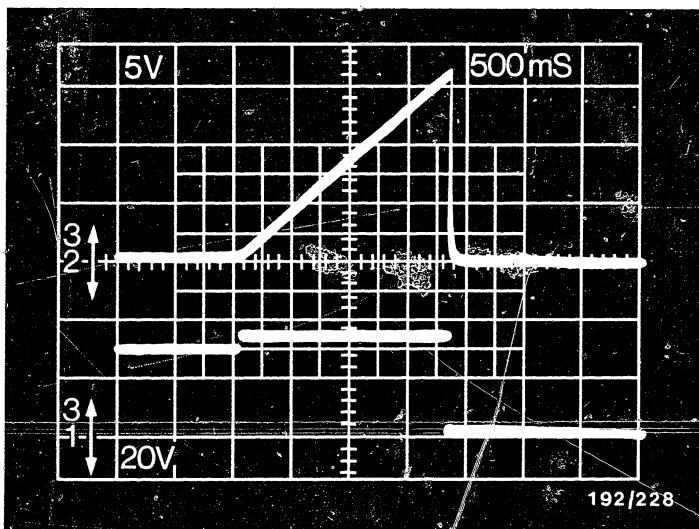
Response voltage	$U_F$	= 31.0 ... 32.0 V
Time delay	$t_F$	= 1.0 ... 5.0 sec
Test voltage	$U_p$	= 32.9 ... 33.1 V

Voltage limitation:

Test voltage	$U_p$	= 80 V
Voltage between $D+$ and $D-$		$\leq 75$ V







- 1 = Base line on oscilloscope - channel 1
- 2 = Base line on oscilloscope - channel 2
- 3 = Positive

Oscilloscope pattern - consequential-damage protection

OK oscilloscope pattern of measuring point 3 (C2) and measuring point 2 (D+)

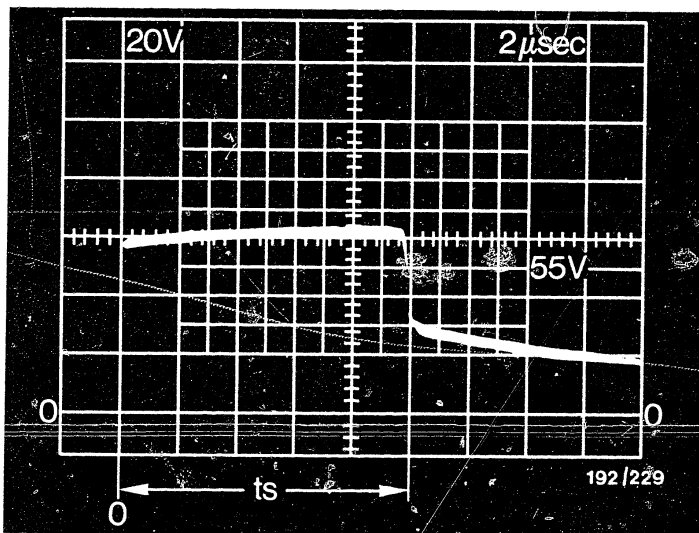
**A3**

Test specifications

Overvolt./conseq.dam.prot. 0 192 900 008







- 1 = Base line on oscilloscope
- 2 = Negative
- 3 = Positive

Oscilloscope pattern - overvoltage protection

OK oscilloscope pattern of measuring point 2 (D+)





## 2. Test equipment, lubricants

### 2.1 Test equipment

#### Measuring oscilloscope

Commercially available

(Resolution 25 MHz  
smallest measuring range  
5mV/cm time-delay cable)

(e.g. Hameg 412)

#### Voltmeter

(Measuring range up to 100 V)

Commercially available

#### Ohmmeter

(Measuring range 1 M $\Omega$ )

(e.g. Bosch Electric-  
Tester ETE 014.00  
Part No. 0 694 101 400)

#### Voltage stabilizer

Commercially available

(80 V min. 2 A)

(e.g. Zentro Electric)

#### Resistance decade

Commercially available

### 2.2 Lubricants

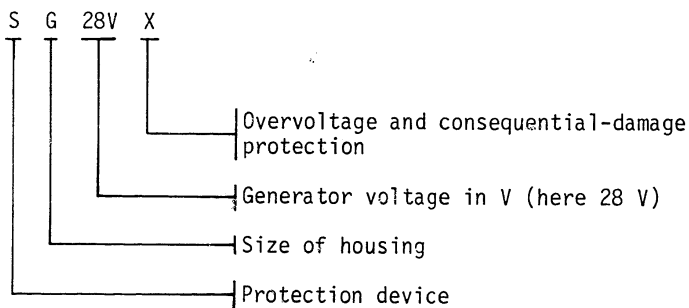
Thermo-lubricant

Part No. 5 942 860 003

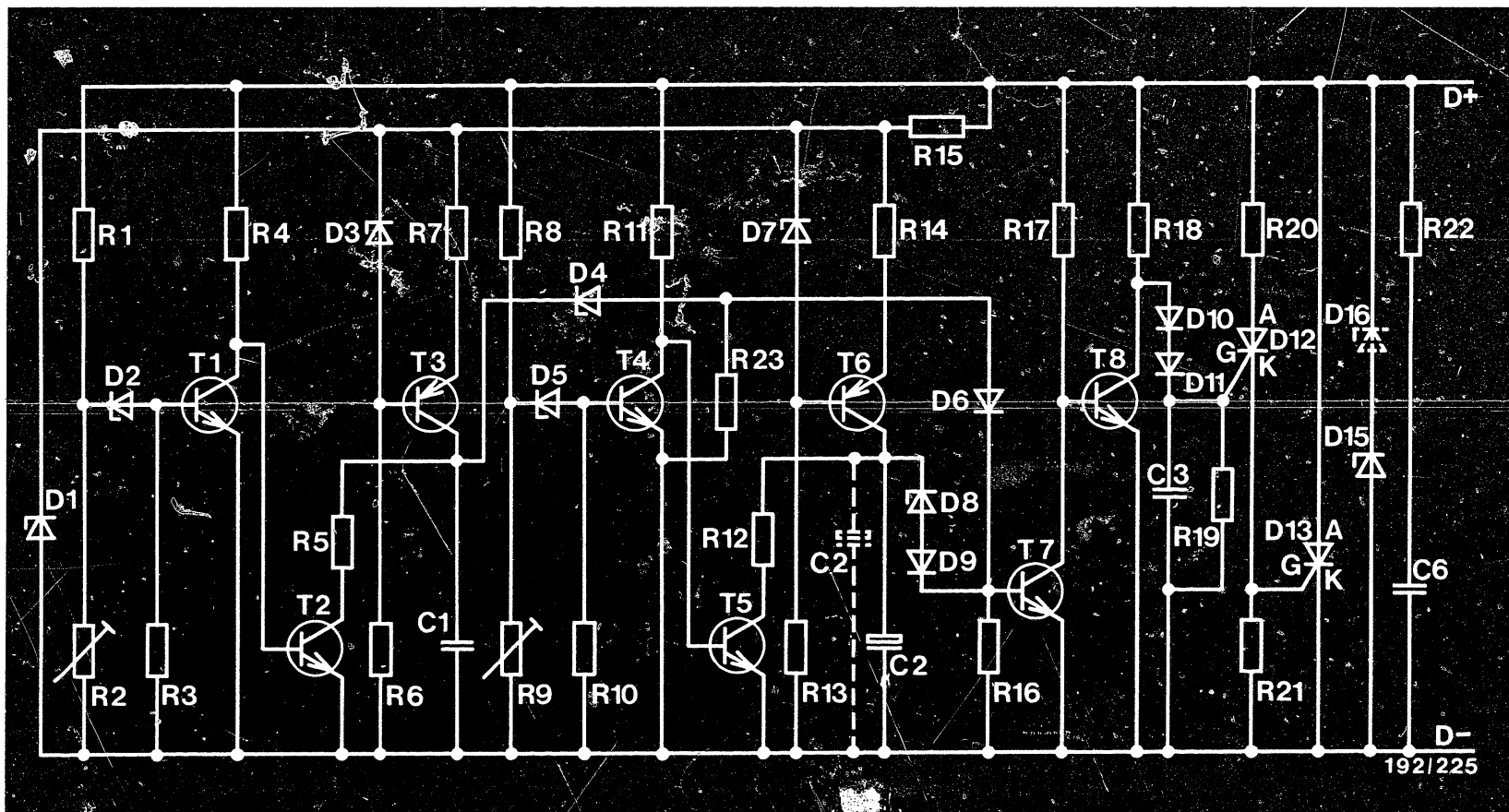




### 3. Explanation of type code







4. Internal circuit diagram of overvoltage/consequential damage protection device 0 192 900 008 (S G 28V X)

D+, D- = Leads for connection of overvoltage protection

**A7**

Internal circuit diagram  
Overvolt./conseq.dam.prot. 0 192 900 008

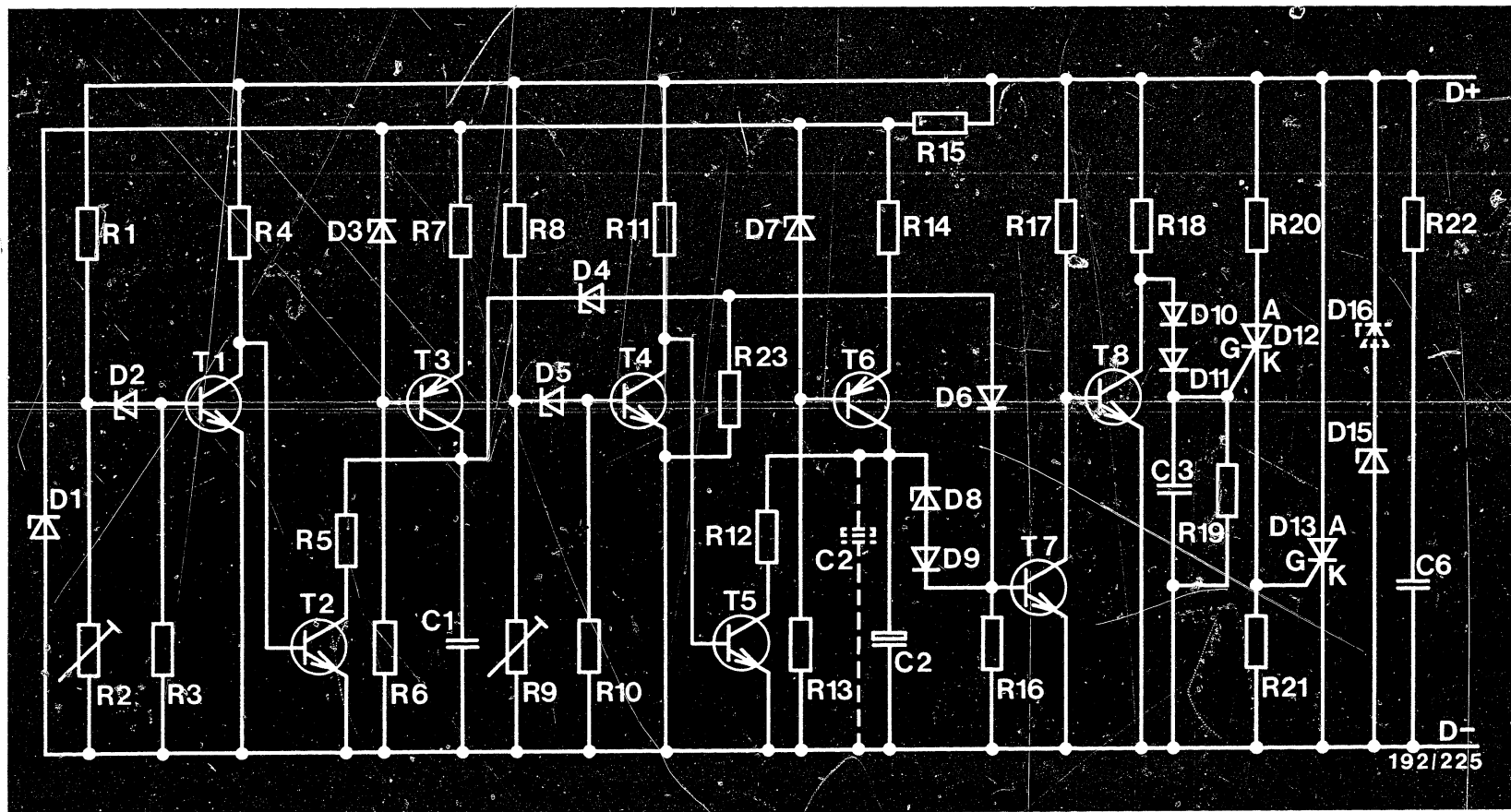


**A8**

Internal circuit diagram  
Overvolt./conseq.dam.prot. 0 192 900 008







192/225

## 5. Functional description

### 5.1 Overvoltage protection:

An overvoltage protection device is installed to protect the vehicle electrical system against destruction as a result of high voltages from the generator. High voltages can occur due to the switching off of loads without battery.

Overvoltage is detected at the tap of voltage divider R1/R2.

**A9**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008



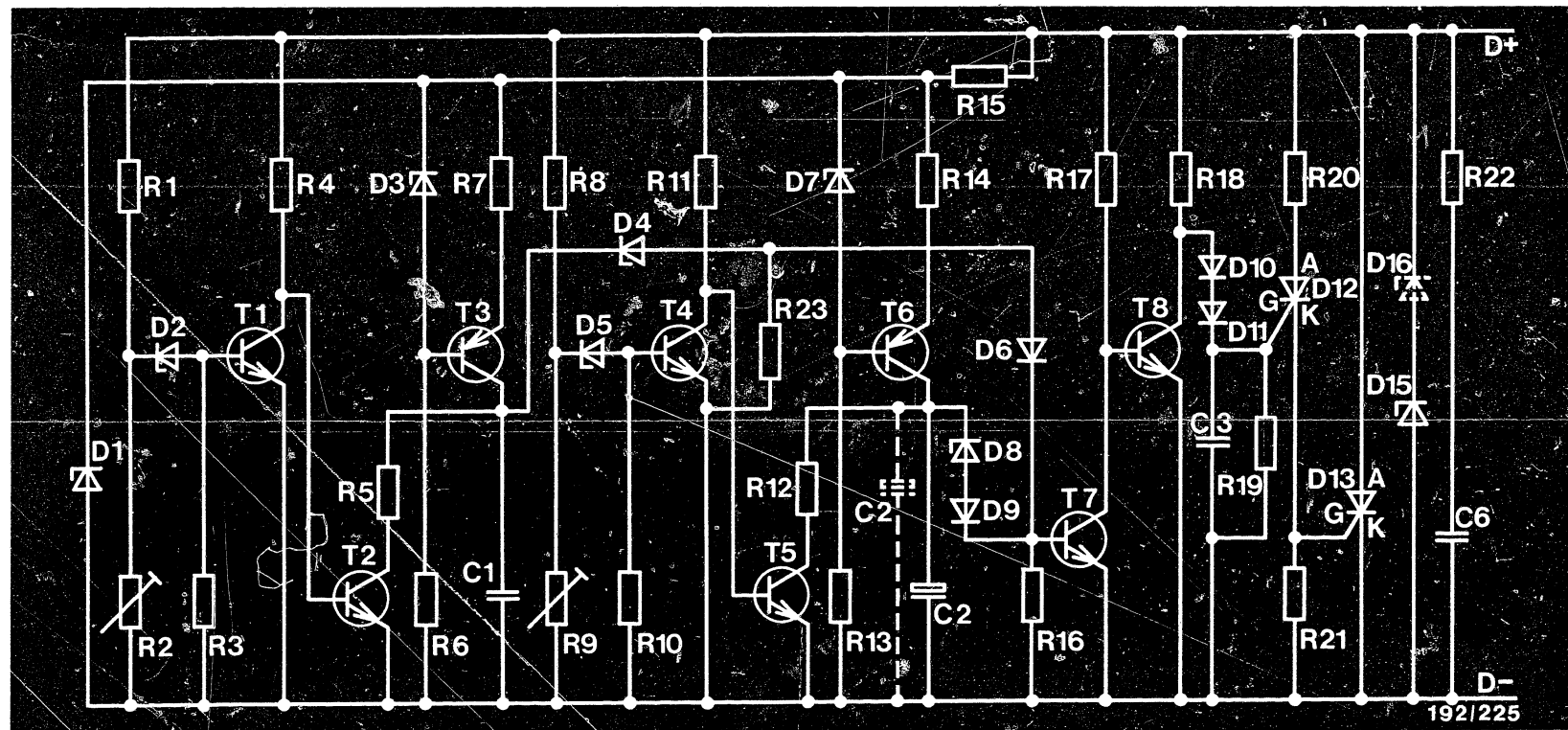
**A10**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008







If voltage  $D+$  is lower than the response voltage  $U_s$  set at the overvoltage protection device, transistor T 1 blocks. T 2 conducts and prevents the charging of capacitor C 1. Transistor T 7 blocks; T 8 conducts, D 12 and D 13 block.

If voltage  $D+$  is greater than  $U_s$ , T 1 conducts, T 2 blocks. Capacitor C 1 is charged by the power source T 3, D 3, R 6, R 7.

If voltage of unidirectional-breakdown diode D 4, D 6,  $U_{BE}$ , T 7 is reached ( $\cong$  time delay), transistor T 7 conducts, T 8 blocks and triggers thyristor D 12.

Thyristor D 12 delivers a large grid current for D 13. This shortens the switching time of D 13. D 13 short-circuits  $D+$  and  $D-$ .

**A11**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008



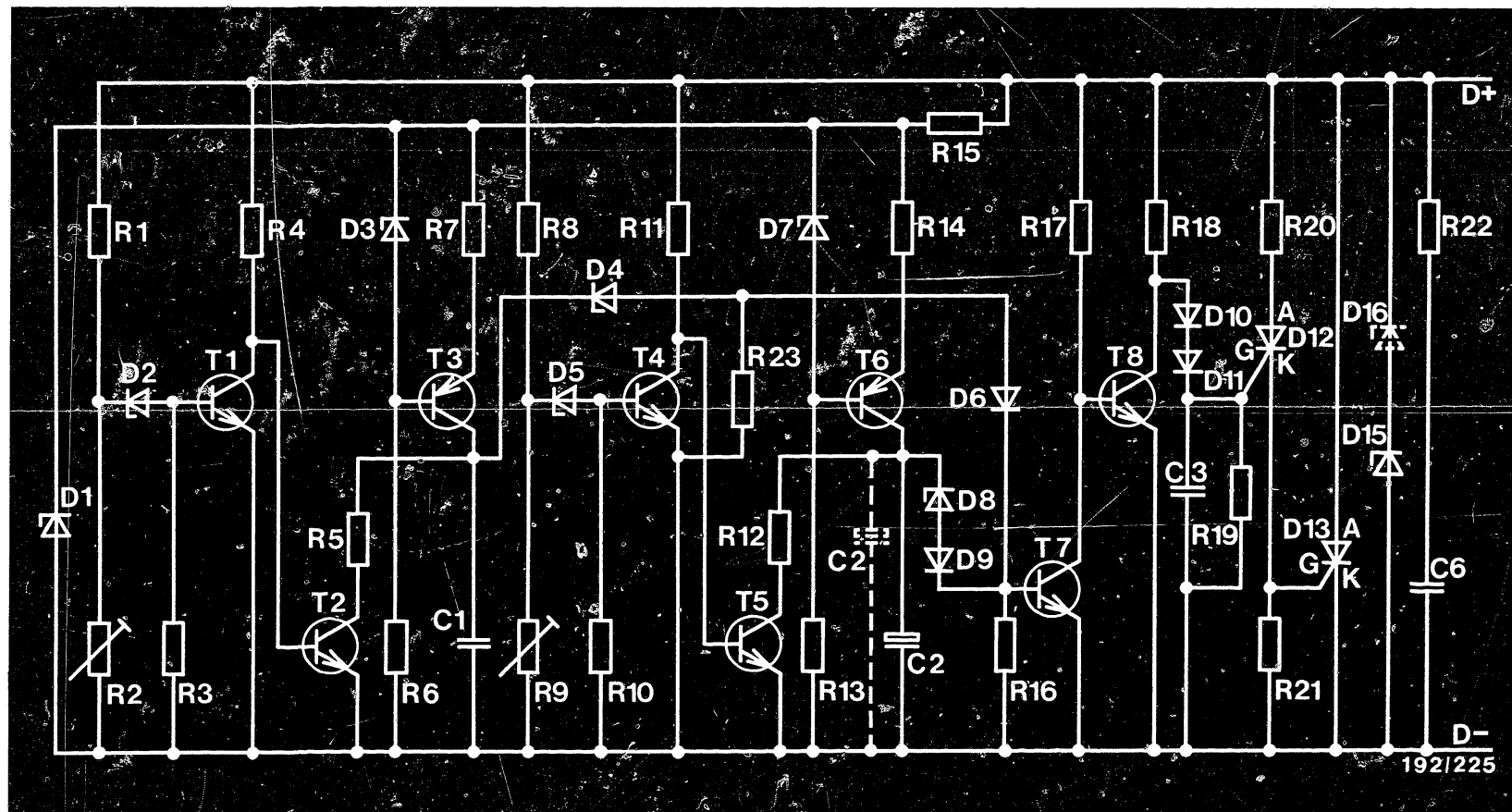
**A12**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008







If the time of the overvoltage is shorter than the time delay, transistor T 1 blocks and capacitor C 1 is discharged through transistor T 2, i. e. T 7 remains blocked, T 8 continues to conduct. D 12 and D 13 are not triggered. D 15 limits the voltage across D+ and D- to  $\leq 80$  V for a maximum of 20  $\mu$ sec.

Short circuit between D+ and D- can only be remedied by shutting down the generator.

**A13**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008



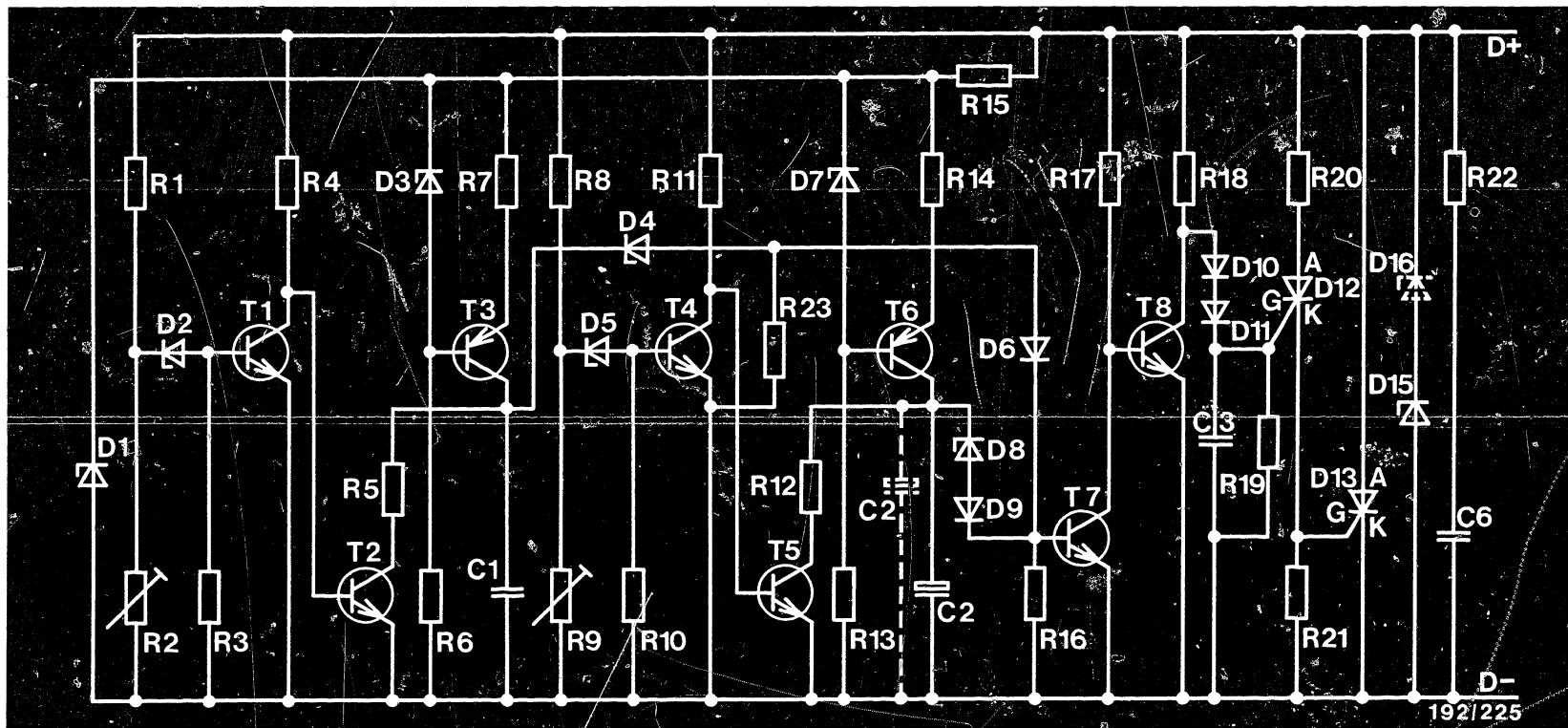
**A14**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008







## 5.2 Consequential-damage protection

The consequential-damage protection device protects the battery against overcharging if the regulator, although conducting, is defective. If the response voltage  $U_F$  set at R 9 is exceeded, T 4 conducts, T 5 blocks. C 2 is charged by the power source T 6, D 7, R 14. If the voltage across capacitor C 2 reaches  $U_{D8} + U_{BE}$  T 7, T 7 conducts, T 8 blocks, D 12 and D 13 fire and short-circuit the generator between D+ and D-.

Short-circuit between D+ and D- can only be remedied by shutting down the generator.

**A15**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008



**A16**

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008





## 6. Trouble-shooting

### 6.1 Visual examination

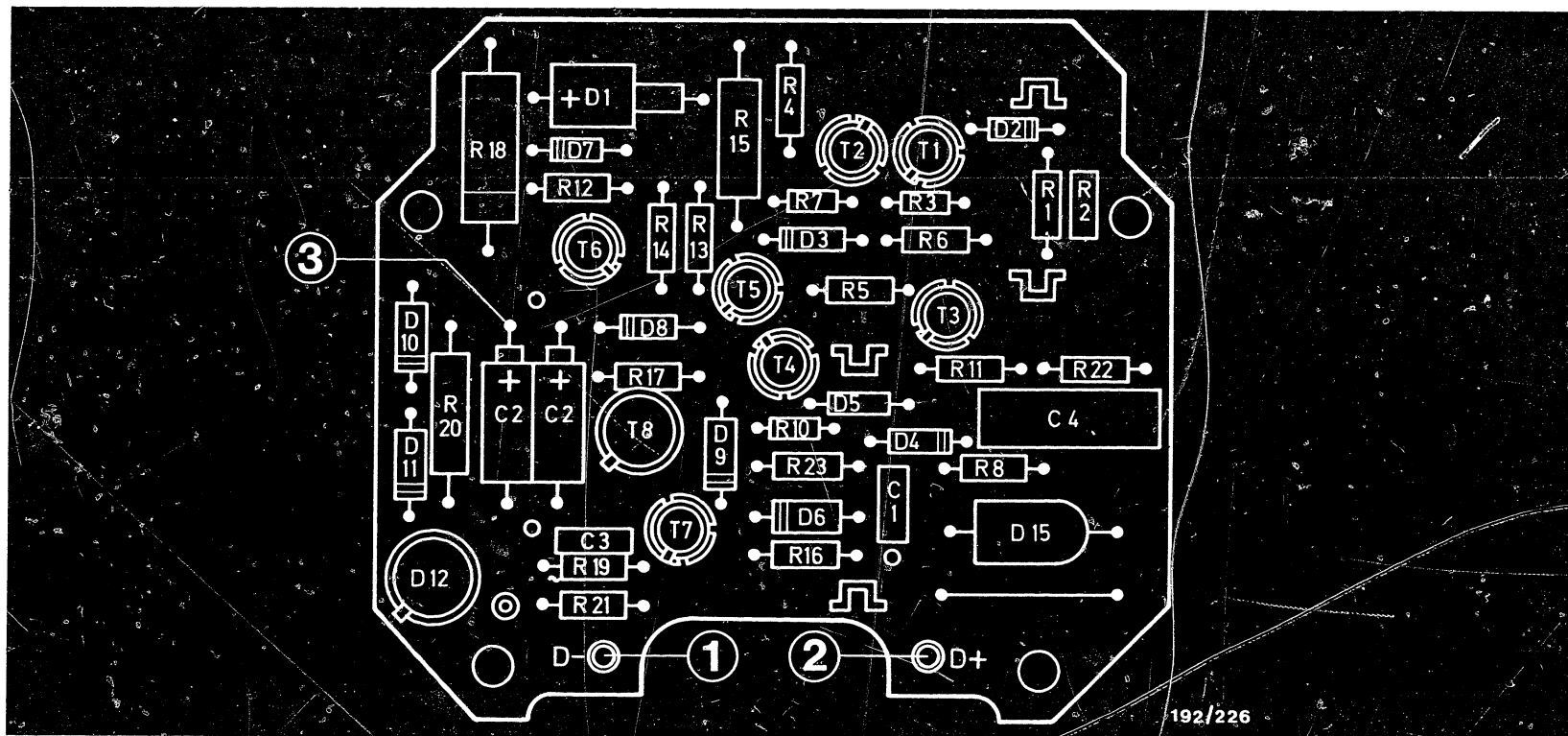
By means of a visual examination, establish whether a component has an immediately recognizable defect. Burnt-off connections are not to be repaired; instead, renew the entire printed-circuit board.

### 6.2 Insulation test

Using ohmmeter, test whether power thyristor D 13 is correctly insulated from the heat sink and the regulator housing. Resistance value min. 1 M $\Omega$ . Renew defective insulating washers. Apply thermal-conduction paste to both sides of insulating washer.







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### 6.3 Trouble-shooting with oscilloscope

To quickly locate a fault, it is practical to test the overvoltage and consequential-damage protection device with an oscilloscope. Operate the oscilloscope only through an isolating transformer.

Measuring points for trouble-shooting with voltage stabilizer and oscilloscope.

Measuring point 3 = + Terminal on capacitor C 2

Measuring point 1 = Reference potential

Measuring point 2 = D+ terminal

**B2**

Trouble-shooting

Overvolt./conseq.dam.prot. 0 192 900 008



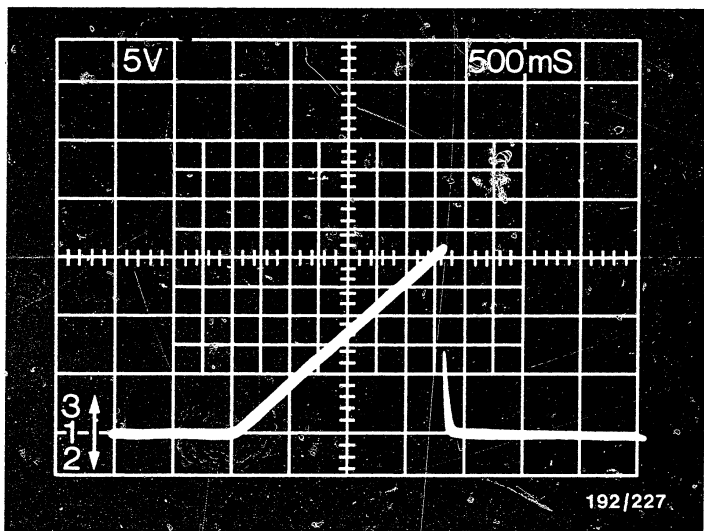
**B3**

Trouble-shooting

Overvolt./conseq.dam.prot. 0 192 900 008







- 1 = Base line on oscilloscope
- 2 = Negative
- 3 = Positive

Oscilloscope pattern - consequential-damage protection

OK oscilloscope pattern of measuring point 3 (capacitor C 2)

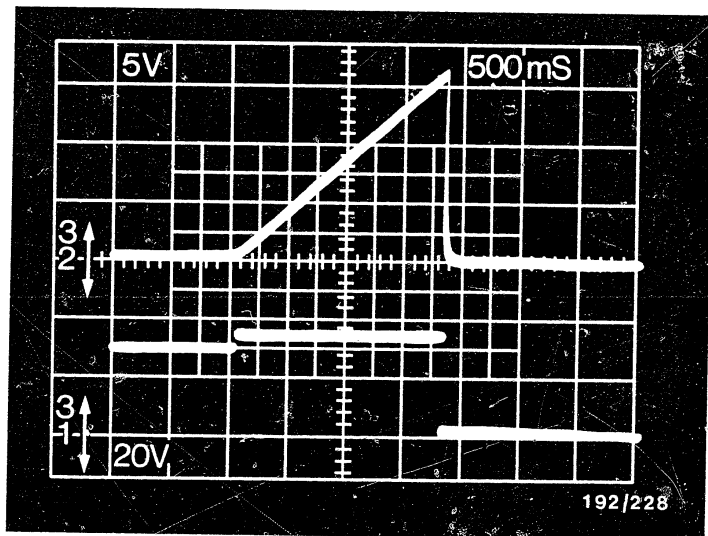
**B4**

Trouble-shooting

Overvolt./conseq.dam.prot. 0 192 900 008







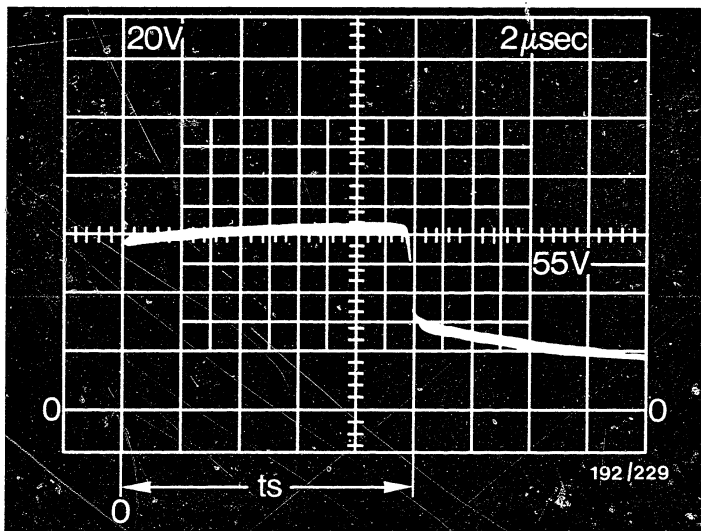
- 1 = Base line on oscilloscope - channel 1
- 2 = Base line on oscilloscope - channel 2
- 3 = Positive

Oscilloscope pattern - consequential-damage protection

OK oscilloscope pattern of measuring point 3 (C 2) and measuring point 2 (D+)







- 1 = Base line on oscilloscope
- 2 = Negative
- 3 = Positive

Oscilloscope pattern - overvoltage protection

OK oscilloscope pattern of measuring point 2 (D+)

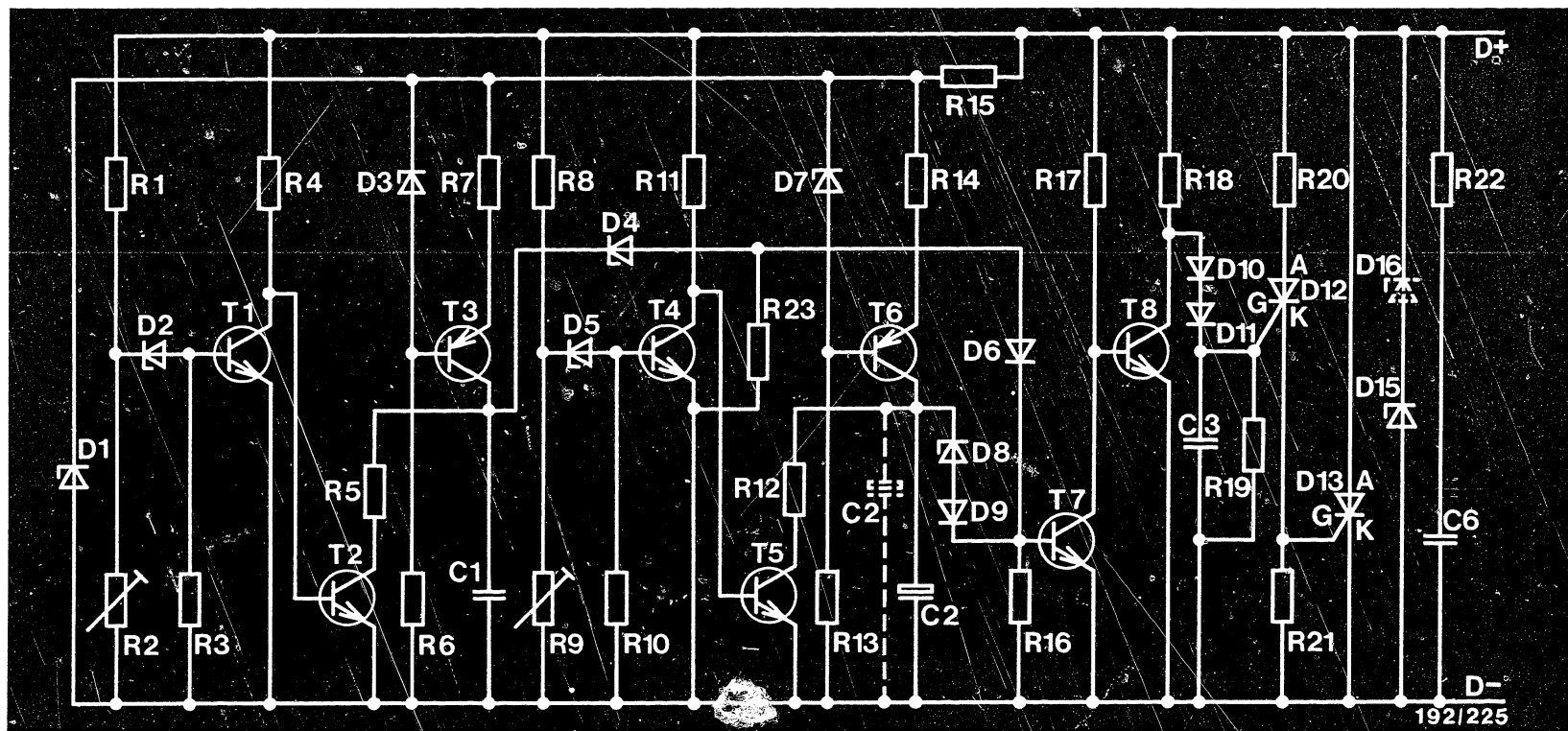
**B6**

Trouble-shooting program

Overvolt./conseq.dam.prot. 0 192 900 008







192/225

#### 6.4 Notes on possible faults

Overvoltage protection responds immediately when generator is started:

$U_{D+}$  must be present (generator operating)

Possible faults:

Unidirectional-breakdown diode D 2 conducting, transistor T 1 conducting, T 2 blocks.  
T 7 conducts, T 8 blocks, thyristors D 12 and D 13 conduct.

**B7**

Trouble-shooting program

Overvolt./conseq.dam.prot. 0 192 900 008



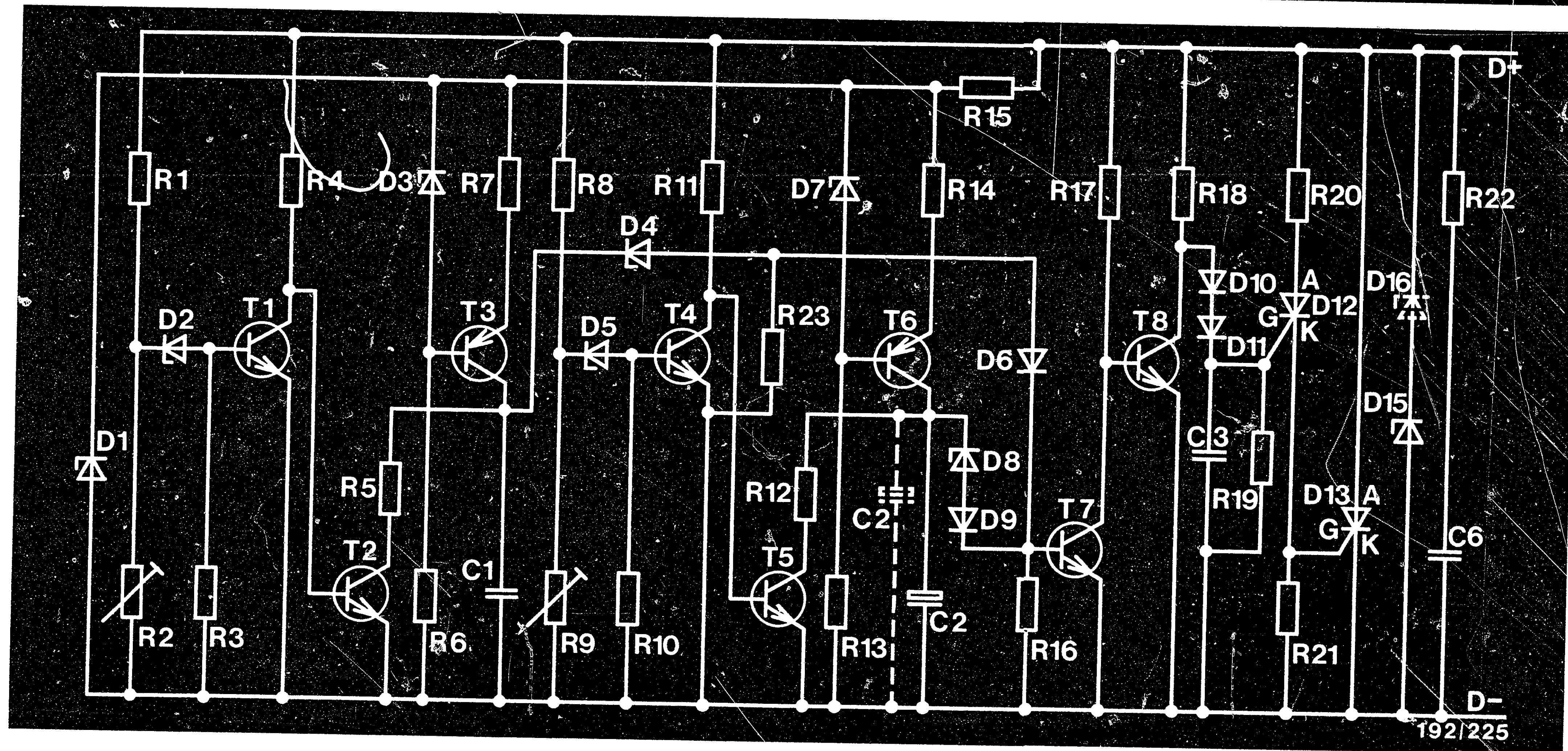
**B8**

Trouble-shooting program

Overvolt./conseq.dam.prot. 0 192 900 008







Consequential-damage protection responds immediately when generator is started:

$U_{D+}$  must be present, generator operating

Possible faults:

Unidirectional-breakdown diode D 5 conducts, transistor T 4 conducts, T 5 blocks, T 7 conducts, T 8 blocks, thyristors D 12 and D 13 conduct.

**B9**

Trouble-shooting program

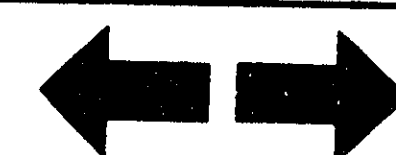
Overvolt./conseq.dam.prot. 0 192 900 008



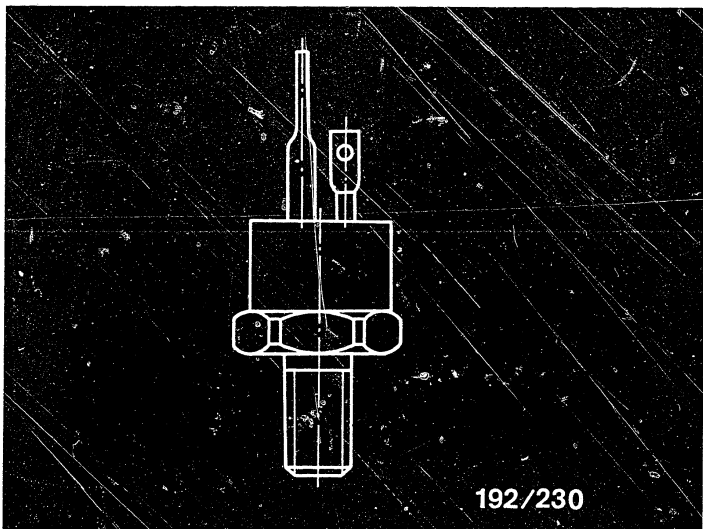
**B10**

Trouble-shooting program

Overvolt./conseq.dam.prot. 0 192 900 008







### 6.5 Notes on renewing individual components

Mark leads so that connections are not mixed up when assembling.

Do not heat semiconductor devices when soldering. To dissipate heat, hold the connecting wire behind the soldered joint with pointed pliers or pincers. After unsoldering a defective component, remove (extract) excess solder from the holes of the printed-circuit board. When soldering in, do not apply too much solder. Caution: For soldering, use only colophonium tin, under no circumstances use paste-type soldering flux. To remove thyristor D 13, first of all unsolder connecting wires.

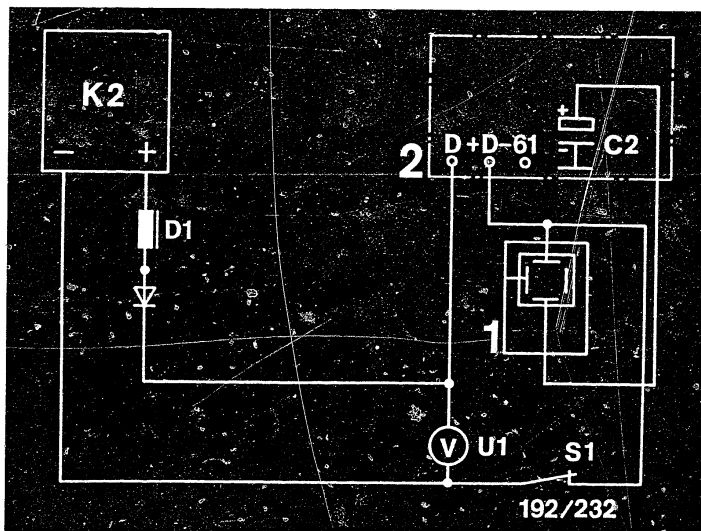
Make sure that the housing of the overvoltage and consequential-damage protection device is not contacted by fanned-out wire leads.











- K 2 = Voltage stabilizer 0 ... 80 V max. 1 A  
 S 1 = Nonlocking switch with normally-closed contact  
 D 1 = Inductor L approx. 2 mH  
 1 = Oscilloscope  
 2 = Object under test (0 192 900 008)

## 7.2 Testing the overvoltage protection:

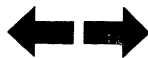
Short-circuit trimming resistor R 9.

Connect voltage stabilizer K 2 to overvoltage and consequential-damage protection device.

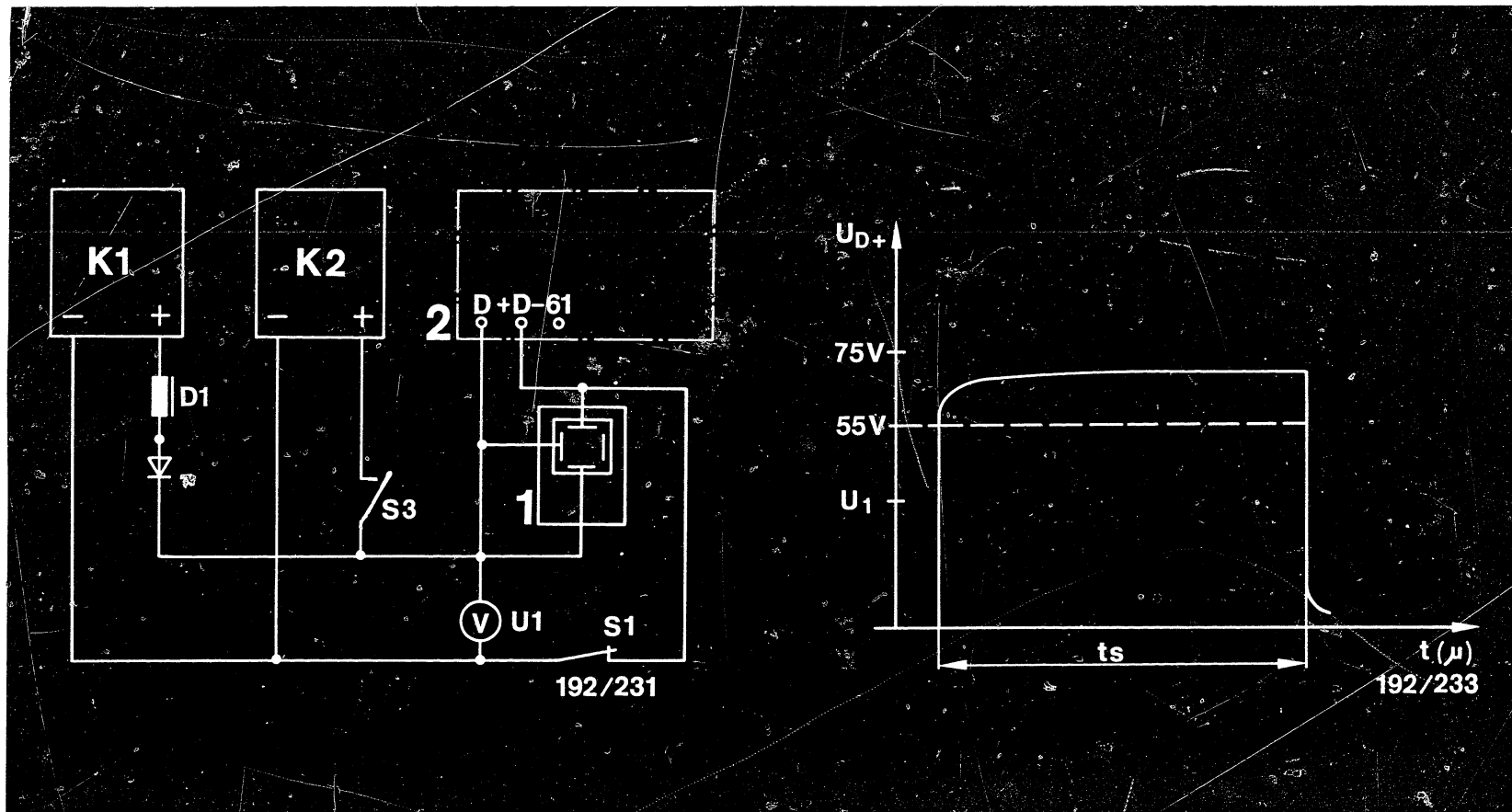
Slowly increase voltage at voltage stabilizer K 2.

At 53.0 V to 55.0 V overvoltage protection device must respond.

Voltage stabilizer K 2 is short-circuited.







### 7.3 Testing the delay time of the overvoltage protection device

Connect oscilloscope according to test circuit.

Set voltage at voltage stabilizer K 1 to 28.0 V, and at voltage stabilizer K 2 to  $80 \pm 0.1$  V.

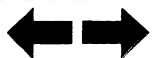
Time delay ( $t_s$ ) between switching-on of nonlocking switch S 3 and dropping of voltage U 1 can be read off on the oscilloscope screen. The set value for the time delay is 0.006...0.02 ms.

The operation can be repeated by pressing button S 1.

**C3**

Testing

Overvolt./conseq.dam.prot. 0 192 900 008



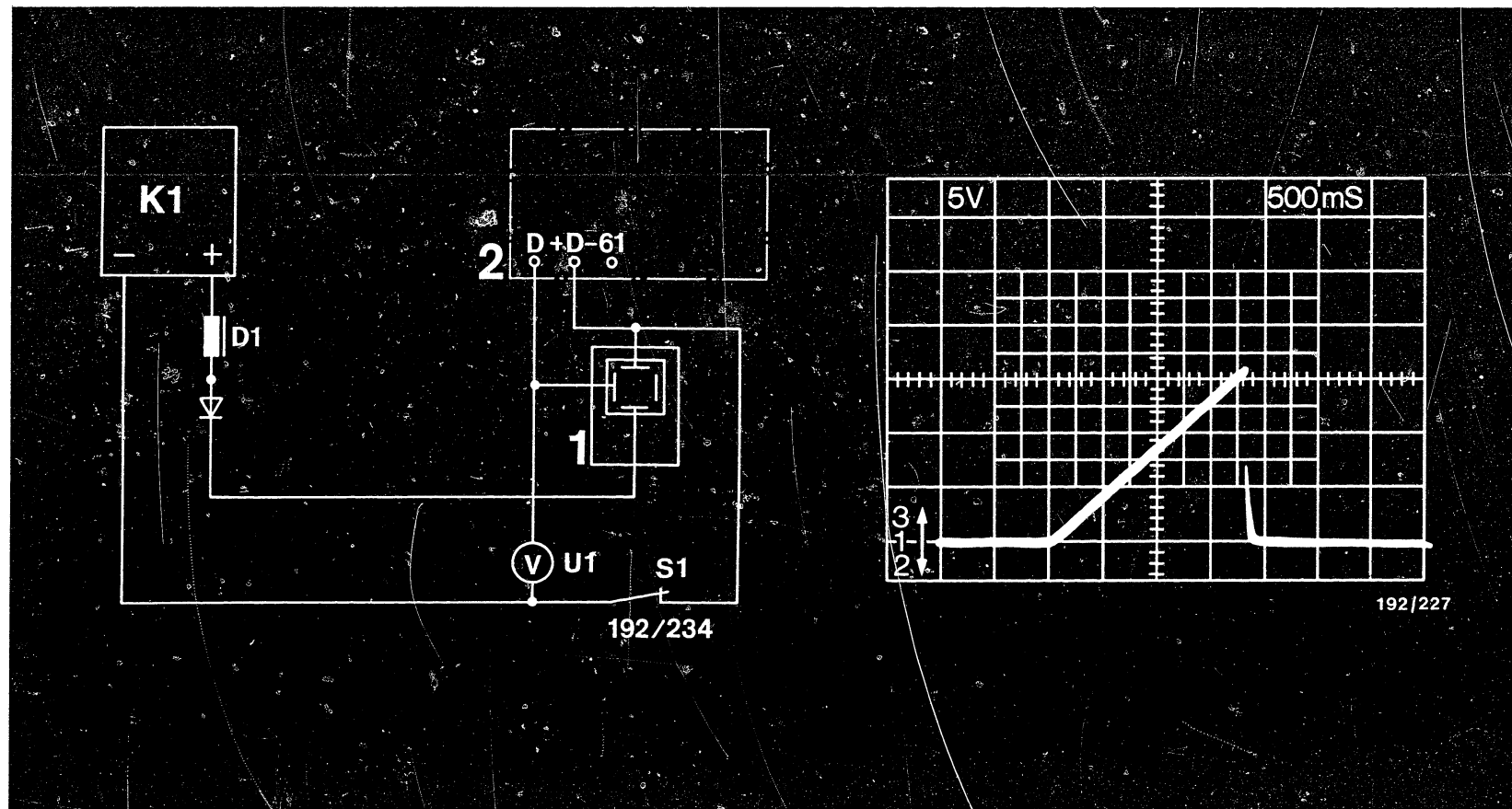
**C4**

Testing

Overvolt./conseq.dam.prot. 0 192 900 008







#### 7.4 Testing the consequential-damage protection device

Connect voltage stabilizer K 1 to overvoltage and consequential-damage protection device. Connect oscilloscope to D+ (measuring point 2) of overvoltage and consequential-damage protection device.

Slowly increase voltage at voltage stabilizer K 1. Voltage at measuring point 2 rises (see picture). Between 31.0 and 32.0 V the consequential-damage protection device must respond. Voltage curve can be read off on oscilloscope screen (see picture).

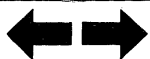
OK oscilloscope pattern of measuring point 3

- 1 = Base line
- 2 = Negative
- 3 = Positive

C5

Testing

Overvolt./conseq.dam.prot. 0 192 900 008



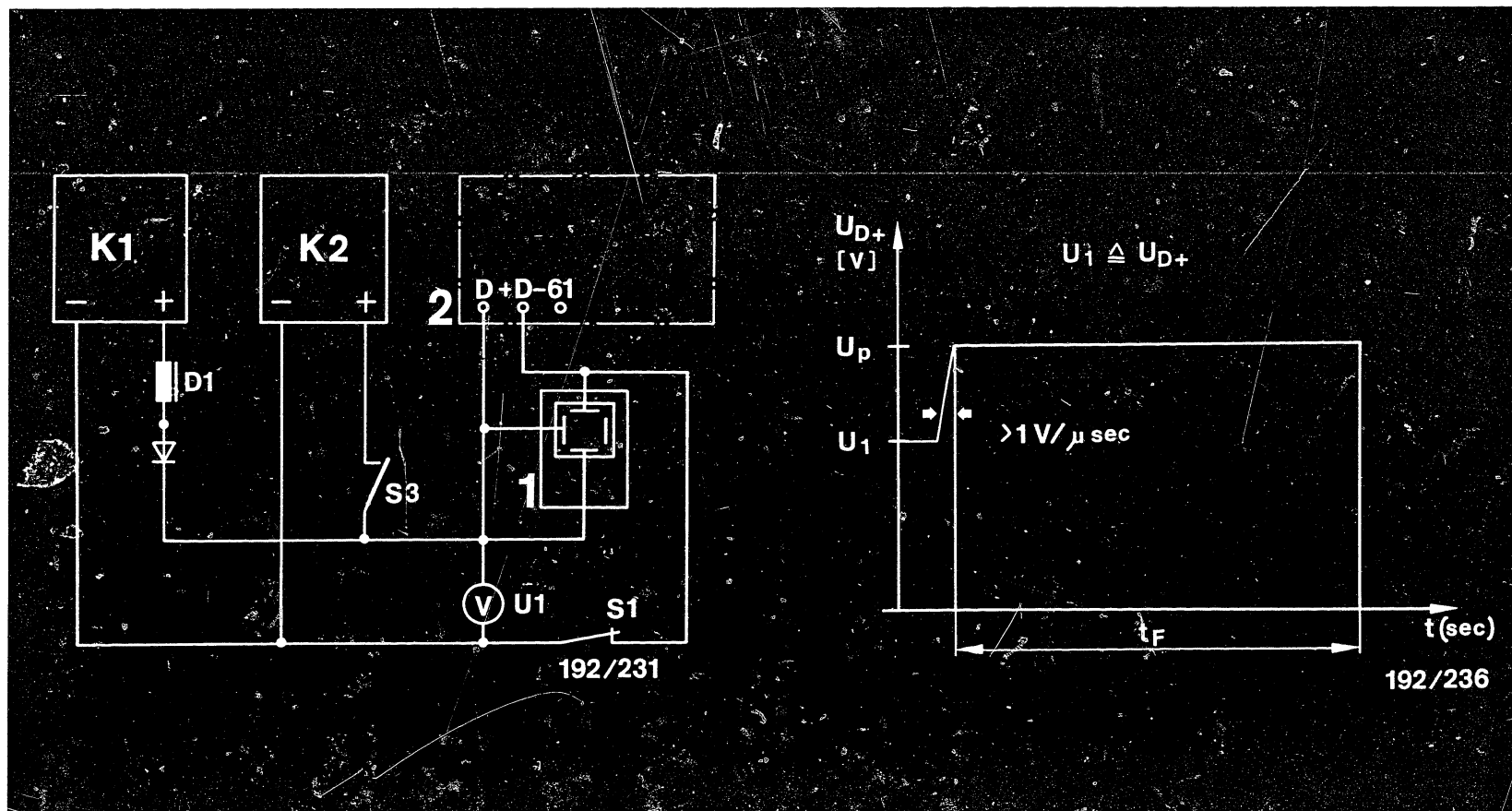
C6

Testing

Overvolt./conseq.dam.prot. 0 192 900 008







### 7.5 Testing the delay time of the consequential-damage protection device

Connect oscilloscope according to test circuit.

Set voltage at voltage stabilizer K 1 to 28.0 V, and at voltage stabilizer K 2 to 33.0 V.

The time delay  $t_F$  between switching on of nonlocking switch 53 and dropping of voltage  $U_1$

can be read off on the oscilloscope screen. The set value for the time delay is 1 - 5 sec.

The operation can be repeated by pressing nonlocking switch T 1.

**C7**

Testing  
Overvolt./conseq.dam.prot. 0 192 900 008

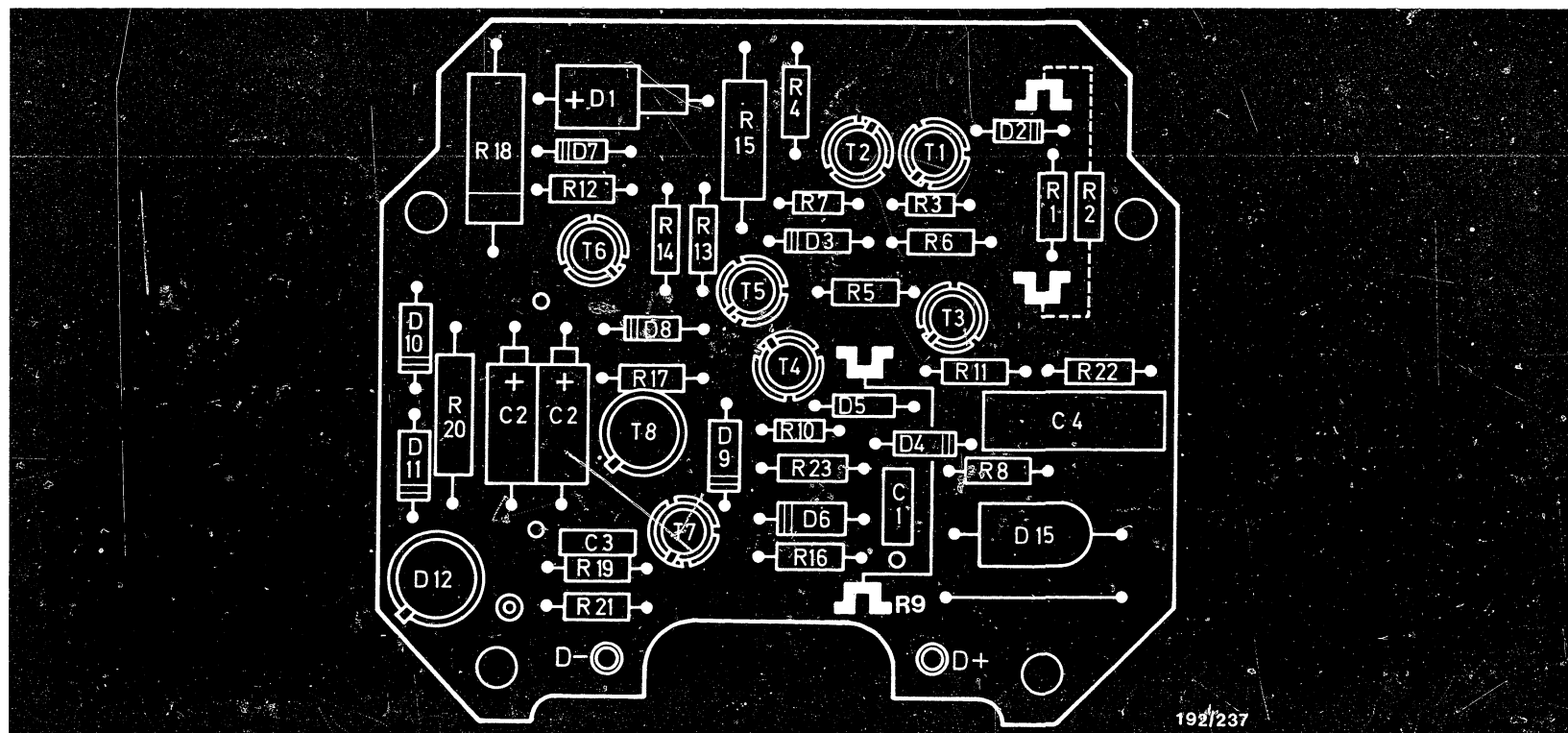


**C8**

Testing  
Overvolt./conseq.dam.prot. 0 192 900 008







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## 8. Setting

### 8.1 Setting the overvoltage protection device

The overvoltage protection device is trimmed with resistor R 2. Short-circuit trimming point R 9. Connect resistance decade to trimming point R 2. Setting on resistance decade 0  $\Omega$ . Connect overvoltage protection device to voltage stabilizer and set a voltage of 53.0 V - 55 V. Increase resistance at resistance decade until the thyristor fires and short-circuits the setting voltage. Install fixed resistor of same value as reading. By changing the response voltage, check whether the installed resistor meets the response voltage requirement.

**C9**

Setting the overvoltage protection

Overvolt./conseq.dam.prot. 0 192 900 008



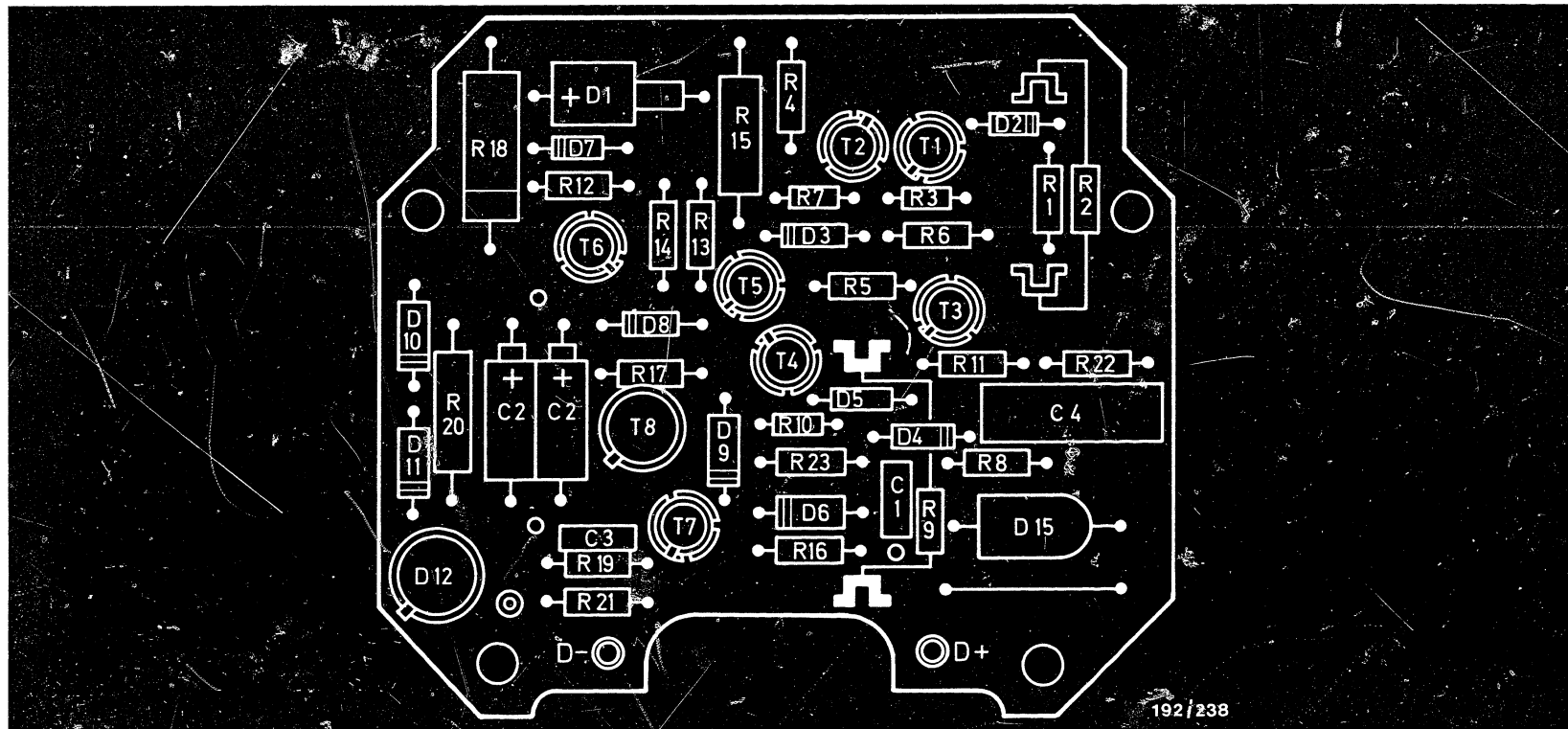
**C10**

Setting the overvoltage protection

Overvolt./conseq.dam.prot. 0 192 900 008







## 8.2 Setting the consequential-damage protection device

The consequential-damage protection device is trimmed with resistor R 9. Connect resistance decade to trimming point R 9. Setting at resistance decade 0  $\Omega$ . To make setting easier, an oscilloscope is connected to + terminal of capacitor C 2 (voltage reading approx. 0 V). When the value of the trimming resistor is increased and the response voltage is reached, the voltage across the capacitor begins to rise. On resistance decade, read off resistance value which causes the voltage across the capacitor to rise, and install fixed resistor of this value.

By changing the response voltage, check the setting of the consequential-damage protection device.

**C11**

Setting the consequent.-damage protection  
Overvolt./conseq.dam.prot. 0 192 900 008



**C12**

Setting the consequent.-damage protection  
Overvolt./conseq.dam.prot. 0 192 900 008





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Automotive Equipment - After-Sales Service  
Department for Technical Publications KH/VDT,  
Postfach 50, D-7000 Stuttgart 1

Published by: After-Sales Service Department for  
Training and Technology (KH/VSK). Press date: 6.1984  
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